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Historical Development of Research Methods in the Information Systems Discipline

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ABSTRACT

In this article, we report on an investigation that integrated the results from twenty meta-studies on research methods as identified by a thorough literature review. By conducting this investigation, we seek to reconstruct the historical development of research methods in the Information Systems (IS) discipline. Major results of the investigation are: Only the classical empirical methods (survey, case study, laboratory experiment, and field experiment) have been the subject of intensive discussion. Survey, case study, and laboratory experiment demonstrate an upward tendency in their historical development during the past forty years (1968-2006), whereas the field experiment does not. The investigation reveals an average adoption rate of 24 percent for the survey, 13 percent for the case study, 10 percent for the laboratory experiment, and 3 percent for the field experiment. Finally, we have not observed radical methodological changes in the IS discipline. Key findings and their implications for the future development of the IS discipline are discussed.

Keywords

Research Method, Survey, Case Study, Laboratory Experiment, Field Experiment, Empirical Research, NeuroIS.

INTRODUCTION

The production of scientific knowledge depends to a great extent on the techniques for collecting, analyzing, and interpreting data and the ways in which the techniques are applied (Simon 1980). Considering this fact, it is no surprise that Information Systems (IS) researchers have been organizing events that exclusively address issues regarding research methods. For example, in 1984 and 1989 colloquia took place at Harvard Business School, and similar colloquia were held in Europe (e.g., the IFIP WG 8.2 Colloquium at Manchester Business School in 1984 and the IFIP TC8/WG8.2 Working Conference in Copenhagen in 1990), as well as in Asia in the 1980s and 1990s (e.g., at the National University of Singapore in 1987). Since the 1980s, the IS community has continued its philosophy of spending sufficient time on methodological issues. The motto of a recent European Conference on Information Systems (ECIS 2007) "Relevant Rigour—Rigorous Relevance" clearly reflects the ongoing importance of methodological debates. The International Conference on Information Systems (ICIS) has also been organizing tracks on research methods for a while. These tracks have recently become more specialized (e.g., at the ICIS in 2006, a track on "Quantitative Research Methods" was organized), which is generally assumed to indicate the discipline's increasing level of maturity (Vessey et al. 2002).

For IS research to progress, it is essential to critically assess the research methods employed by the community. To be able to do this, one has to know the historical development of the various research methods and their current adoption rates. Examination of the research methods' development patterns may provide valuable insights into the future development of research methodology in the IS discipline.

In a recent essay on the identity of the IS discipline, Klein and Hirschheim (2008, p. 298) write: "Gadamer provides philosophical support for our contention of the relationship between having a shared history and forming a strong identity and belonging. In his theory of understanding … he contends that a shared sense of history provides the ultimate grounding and background information (pre-understanding) for communication in large and diverse collectives such as societies (and by extension to diverse disciplines). *A fortiori*, the same should apply to the IS discipline as it continues to grow and diversify."

Bearing this argumentation in mind, the main motivation of the present article is to advance the recent discussion about the identity of the IS discipline (e.g., Hirschheim 2006, Lyytinen and King 2006, Weber 2006). Knowing one's history facilitates identity formation. Moreover, knowing one's past is important for coping with future challenges (Webster and Watson 2002).

Over the past decades, many meta-studies have been published in the IS discipline that analyze the adoption of research methods. These meta-studies typically differ with regard to publication outlets analyzed, time periods examined, and research methods investigated. Considering this diversity, in the present article we systematically integrate the results of twenty meta-studies on research methods as identified by a thorough literature review. In particular, we address the following two research questions:

- What are the average adoption rates for important research methods?
- How did these research methods develop historically?

The remainder of this article is structured as follows: In the next section, we present our methodology. Then, we briefly discuss the diversity of methodological concepts in IS research and we present the results of our investigation. Afterwards, we discuss the key findings and their implications for IS research and we outline limitations, as well as possible directions for future research. We close with a brief summary and the contribution of our investigation.

METHODOLOGY

The objective of the present investigation is to synthesize the results of meta-studies reporting on the adoption of IS research methods. In carefully selecting the articles to be reviewed, our intent was to ensure that the sample represented the wide range of meta-studies conducted in IS. We performed queries on the basis of search terms and their combinations (e.g., Research Methods *and* Information Systems). We searched the following databases and sources: *ACM Portal*, *AIS Electronic Library*, *EBSCO HOST*, *IEEE Xplore Digital Library*, and *ISI Web of Knowledge*. These databases cover a large quantity of the publication outlets listed in the section "Journals and Journal Rankings" published on the AIS website (*www.AISnet.org*).

Table 1 depicts the twenty meta-studies that we identified and it shows their most important characteristics. Alavi and Carlson (1992), for example, investigated (i) a time period from 1968 to 1988 (twenty-one years), (ii) eight different research methods, (iii) a sample size of 908 papers, and (iv) eight different publication outlets (indicated in detail in Table 2). Important descriptive statistics for the four characteristics are shown on the right side of Table 1.

In order to be effectively considered for our investigation, a meta-study had to: (i) investigate the adoption of at least one research method (e.g., survey), (ii) have a clear focus on the IS discipline, (iii) be methodologically based on content analysis (i.e., one or more researchers classify papers by using a predefined classification system), (iv) investigate journal and proceeding articles (and not dissertations or any other source of publication), and (v) use the total number of articles as the reference parameter for the calculation of the adoption rate of a research method (and not, for example, the number of empirical articles only).

Table 1. Overview of the Studies Investigated

	Alavi and Carlson 1992	Alavi et al. 1989	Ayaniso et al. 2007	Chen and Hirschheim 2004	Claver et al. 2000	Dubé and Paré 2003	Farhoomand and Drury 1999	Farhoomand 1987	Glass et al. 2004	Grover et al. 1993	Hamilton and Ives 1982	King and He 2005	Lending and Wetherbe 1992	Lightner and Nah 1998	Mingers 2003	Palvia et al. 2003	Palvia et al. 2004	Seddon and Scheepers 2006	Vessey et al. 2002	Vogel and Wetherbe 1984	MEAN	MEDIAN	MINIMUM	MAXIMUM	STANDARD DEVIATION
Time period investigated	1968-1988	1968-1988	2000-2006	1991-2001	1981-1997	1990-1999	1985-1996	1977-1985	1995-1999	1980-1989	1970-1979	1999-2004	1984-1990	1993-1997	1993-2000	1993-1997	1998-2003	2003-2004	1995-1999	1977-1983	1968 - 2006				
Number of years investigated	21	21	7	11	17	10	12	9	5	10	10	6	7	5	8	5	6	2	5	7	9.2	7.5	2	21	5.06
Number of research methods investigated	8	7	16	5	7	1	4	4	17	1	6	5	7	5	13	12	13	10	16	7	8.2	7	1	17	4.71
Sample size	908	792	549	1893	1121	1691	2098	530	488	1336	532	411	744	210	902	843	1226	83	488	389	862	768	83	2098	538
Number of outlets investigated	8	7	3	8	2	7	9	6	5	9	15	3	13	2	6	7	7	2	5	15	6.95	7	2	15	3.81

Next, we researched the number of times a particular publication outlet was analyzed by the twenty meta-studies. Younger journals (e.g., *Information Systems Research*) did not have an equal chance of being included as older journals (e.g., *MIS Quarterly*) simply by virtue of their age. Table 2 exhibits in detail the number of considerations of every single publication outlet across all twenty studies. Additionally, Table 2 shows all the outlets that were included in a particular meta-study.

Seddon and Scheepers (2006), for example, only analyzed articles published in two journals (*MIS Quarterly* and *Information Systems Research*). In contrast, Hamilton and Ives (1982) investigated fifteen journals, the largest sampling of all the studies we reviewed.

Table 2. Publication Outlets

		Alavi and Carlson 1992	Alavi et al. 1989	Ayanso et al. 2007	Chen and Hirschheim 2004	Claver et al. 2000	Dubé and Paré 2003	Farhoomand and Drury 1999	Farhoomand 1987	Glass et al. 2004	Grover et al. 1993	Hamilton and Ives 1982	King and He 2005	Lending and Wetherbe 1992	Lightner and Nah 1998	Mingers 2003	Palvia et al. 2003	Palvia et al. 2004	Seddon and Scheepers 2006	Vessey et al. 2002	Vogel and Wetherbe 1984	Number of considerations of an outlet across all studies
1	MIS Quarterly	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	20
2	Information Systems Research			•	•		•	•		•			•	•	•	•	•	•	•	•		13
3	Management Science	•	•					•	•	•	•	•		•			•	•		•	•	12
4	Journal of Management Information Systems	•		•	•		•	•		•	•		•				•	•		•		11
5	Communications of the ACM	•	•					•	•		•	•		•			•	•			•	10
6	Decision Sciences	•	•							•	•	•		•			•	•		•	•	10
7	Information and Management					•	•	•	•		•	•		•			•	•			•	10
8	Harvard Business Review	•	•						•			•		•							•	6
9	Data Base	•	•									•		•							•	5
10	Sloan Management Review	•	•									•		•							•	5
11	Academy of Management Journal										•	•		•							•	4
12	European Journal of Information Systems				•		•	•								•						4
13	Accounting Review											•		•							•	3
14	ACM Transactions on Database Systems											•		•							•	3
15	Proceedings of the ICIS				•			•			•											3
16	Accounting, Management and IT				•											•						2
17	ACM Computing Surveys													•							•	2
18	Computing Surveys										•	•										2
19	Information Systems Journal				•											•						2
20	Journal of Information Technology				•											•						2
21	Systems, Objectives and Solutions								•												•	2
22	Academy of Management Review											•										1
23	Datamation																				•	1
24	IBM Systems Journal											•										1
25	Information and Organization						•															1
26	Information Technology and People						•															1
27	Journal of Accountancy											•										1
28	Journal of Data Education																				•	1
29	Journal of Strategic Information Systems							•														1

In general, Table 2 exhibits that the focus of the twenty studies was clearly on mainstream journals, irrespective of being a "pure" IS journal. That is, journals such as *Management Science* (started in 1954), *Communications of the ACM* (1958), *Decision Sciences* (1970), *Harvard Business Review* (1922), and *Sloan Management Review* (1960) were considered in at least five of the twenty studies, whereas well-known IS journals such as *Information Systems Journal* (1991), *Journal of Information Technology* (1986), *Information and Organization* (2001, from 1991 to 2000 known as *Accounting, Management and IT*), *Information Technology and People* (1982), and *Journal of Strategic Information Systems* (1991) were considered only once or twice. Considering the fact that nine of the twenty studies we reviewed were published in the 1980s and 1990s (and not in the 2000s), it is clear that it was not possible that these nine studies could consider the relatively young IS journals in their investigations. However, since *Information Systems Research*, which began in 1990, was considered in thirteen

studies, both journal age *and* perceived importance in the IS community obviously affected the consideration of a publication outlet in the twenty meta-studies.

DIVERSITY OF METHODOLOGICAL CONCEPTS

As shown in Table 3, we identified a total of fifty distinct methods. A marked cell in Table 3 indicates that the respective author(s) did analyze this particular method, while a blank cell indicates that the respective author(s) did not. In particular, Table 3 reveals the diversity of methodological concepts in the IS discipline. These concepts consist of research methods (e.g., laboratory experiment), epistemological positions (e.g., critical theory), research types (e.g., qualitative research), and data collection techniques (e.g., interviews) (Kerlinger and Lee 2000).

The research methods listed in Table 3 can be divided into (i) classical empirical methods (e.g., survey, case study, lab experiment, or field experiment; Van Horn 1973, p. 173); (ii) design science methods (e.g., instrument development, development of a tool, or engineering; Hevner et al. 2004; Van Horn 1973, p. 178); (iii) mathematical methods (e.g., mathematical model, theorem proof, computer simulation / mathematical modeling, or mathematical proof; Vogel and Wetherbe 1984, p. 6); and finally, (iv) conceptual methods (e.g., speculation / commentary, subjective / argumentative, or illustrative; Hamilton and Ives 1982, p. 340).

Table 3. Diversity of Methodological Concepts

		Alavi and Carlson 1992	Alavi et al. 1989	Ayanso et al. 2007	Chen and Hirschheim 2004	Claver et al. 2000	Dubé and Paré 2003	Farhoomand and Drury 1999	Farhoomand 1987	Glass et al. 2004	Grover et al. 1993	Hamilton and Ives 1982	King and He 2005	Lending and Wetherbe 1992	Lightner and Nah 1998	Mingers 2003	Palvia et al. 2003	Palvia et al. 2004	Seddon and Scheepers 2006	Vessey et al. 2002	Vogel and Wetherbe 1984	Number of research method consideration across all studies
1	**Survey**	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	**19**
2	**Case Study**	●	●	●	●	●	●	●	●	●		●		●		●	●	●	●	●	●	**17**
3	**Laboratory Experiment**	●	●	●	●	●		●	●	●		●	●	●	●		●	●		●	●	**16**
4	**Field Experiment**	●	●	●	●	●		●	●	●		●	●	●			●	●		●	●	**15**
5	Action Research			●	●					●						●			●	●		6
6	Simulation			●						●						●			●	●		5
7	Ethnography			●						●						●				●		4
8	Grounded Theory			●						●						●				●		4
9	Interview												●			●	●	●				4
10	Secondary Data	●											●				●	●				4
11	Concept Implementation (Proof of Concept)			●						●										●		3
12	Conceptual Analysis			●						●										●		3
13	Conceptual Analysis / Mathematical			●						●										●		3
14	Data Analysis			●						●										●		3
15	Instrument Development			●						●										●		3
16	Literature Review / Analysis			●						●										●		3
17	Protocol Analysis			●						●										●		3
18	Conceptual					●						●										2
19	Content Analysis															●		●				2
20	Description	●	●																			2
21	Development of Tool	●	●																			2
22	Engineering													●							●	2
23	Experiment															●			●			2
24	Ex-post Description	●	●																			2
25	Frameworks and Conceptual Models																●	●				2
26	Library Research																●	●				2
27	Literature Analysis																●	●				2
28	Mathematical Model																●	●				2
29	Qualitative Research																●	●				2
30	Speculation / Commentary																●	●				2
31	Subjective / Argumentative													●							●	2
32	Systems Evaluation			●																●		2
33	Theorem Proof													●							●	2

Table 3. Diversity of Methodological Concepts (continued)

34	Analytic																		●		1
35	Applied Concepts					●															1
36	Archival Data Analysis																		●		1
37	Computer Simulation / Mathematical Modelling													●							1
38	Conceptual / Others													●							1
39	Consultancy														●						1
40	Critical Theory														●						1
41	Experimental Simulations													●							1
42	Hermeneutics									●											1
43	Illustrative					●															1
44	Mathematical Proof									●											1
45	Meta Analysis																		●		1
46	Observation														●						1
47	Opinion																		●		1
48	Participant Observation														●						1
49	Review																		●		1
50	Tutorial, Review, Other											●									1

Note: Due to the fact that Mingers (2003) and Seddon and Scheepers (2006) do not distinguish between laboratory and field experiment, we list experiment as an own class.

It is important to note that the twenty meta-studies have a strong focus on four research methods only (see Table 3): survey, case study, laboratory experiment, and field experiment. The remaining forty-six methods were only investigated in a few studies. In the following, we discuss the survey, case study, laboratory experiment, and field experiment in detail.

ADOPTION OF RESEARCH METHODS AND THEIR HISTORICAL DEVELOPMENT

To answer the two research questions of the present article, necessary steps in our investigation were to assess the adoption of the most dominant research methods (survey, case study, laboratory experiment, and field experiment) and to reconstruct their historical development.

In order to calculate the adoption rate of a research method in a particular year, we calculated the mean—see "Mean (Adoption Rate of the Survey)" in Figure 1. For example, in the year 1968 we calculated an adoption rate of 19 percent, [19.60+19.19]/2 (note that this value is rounded due to space limitation in the cells). For 1985, for example, we calculated a survey adoption rate of 25 percent (see Figure 1) on the basis of seven studies, that is, there were seven data points. To help the reader assess the reliability of the adoption rate in a given year, we depict in the bottom of Figure 1 (survey), Figure 2 (case study), Figure 3 (laboratory experiment), and Figure 4 (field experiment) not only the historical development of a research method, but also the number of studies on which each yearly adoption rate is based. The more data points (the more studies), the more reliable the adoption rate results of a particular year. In the following, we briefly outline the most striking observations with regard to each research method.

We state for each research method the linear function $f(x)=mx+b$ that we calculated on the basis of the thirty-nine data points (1968-2006); m denotes the slope of the function and b is the y-intercept. Additionally, we calculated the coefficient of determination R^2, where $0 \leq R^2 \leq 1$, which denotes the strength of the linear association between x (time) and y (adoption rate of a particular research method).

Drawing upon the linear function $f(x)=mx+b$, in the case of the survey method R^2 amounts to 0.503 (Figure 1), which means that 50.3 percent of the total variation in y can be explained by the linear relationship between x and y (as described by the regression equation). The other 49.7 percent of the total variation in y remains unexplained.

By stating R^2 we do not claim that the independent variable *time* is a true cause of the changes in the dependent variable *adoption of a research method*; R^2 is a measure that shows how well the regression line represents the data. However, in Table 4 (see Appendix) we summarize twenty-two criteria, which may affect research method selection. We grouped them into four categories, namely (1) object of research, (2) research environment, (3) individual-related factors, and (4) method-related factors. Table 4 may help the reader to interpret the historical development of the survey, case study, laboratory experiment, and field experiment, which are presented in Figures 1, 2, 3, and 4.

Survey

The historical development of the survey shows an upward tendency (m = 0.3677; Figure 1). The most important descriptive statistics for the adoption rate (in percent) are: mean: 24, median: 24, standard deviation: 6. In the 1990s, the survey showed its maximum adoption rate of 35 percent, wherein more than one third of the total IS research employed the survey method. Interestingly, from 1997 the adoption declined sharply. Afterward, it increased slightly to reach a level that amounts approximately to its average adoption rate of 24 percent. Altogether, the survey has been the dominant research method in IS for the past forty years.

Adoption Rate of the Survey		Note	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
1	[Alavi & Carlson 1992]		19.60																																						
2	[Alavi et al. 1989]		19.19																																						
3	[Hamilton & Ives 1982]					10.8					6.2																														
4	[Vogel & Wetherbe 1984]												32.10																												
5	[Farhoomand 1987]												25.40																												
6	[Grover et al. 1993]														16.99																										
7	[Claver et al. 2000]															17.81			36.54			31.08			43.14			43.36		52.31										
8	[Lending & Wetherbe 1992]																		28.13																						
9	[Farhoomand & Drury 1999]																				30.56																				
10	[Dubé & Paré 2003]	A																																						
11	[Chen & Hirschheim 2004]	B																							20	28	23	29	29	24	24	24	24	18	21					
12	[Lightner & Nah 1998]																										56														
13	[Palvia et al. 2003]																										36.18														
14	[Mingers 2003]																										15.41														
15	[Glass et al. 2004]																													27.2											
16	[Vessey et al. 2002]																													26.8											
17	[Palvia et al. 2004]																																32.46								
18	[King & He 2005]																																	23.84						
19	[Seddon & Scheepers 2006]																																				21.68			
20	[Ayanso et al. 2007]																																							26.71
Mean (Adoption Rate of the Survey)		B	19	19	17	17	17	17	17	15	15	20	20	20	23	22	22	22	24	25	25	24	24	27	34	31	34	34	35	33	33	34	25	25	23	26	28	26	24	27	27
Studies per Year			2	2	3	3	3	3	3	3	3	5	5	5	5	6	6	6	6	7	6	6	6	4	3	3	3	6	6	8	8	7	5	6	5	4	3	4	3	1	1

Note: A = Study does not include the survey method / B = Figures in the row are rounded to whole numbers due to space limitation in the cells.

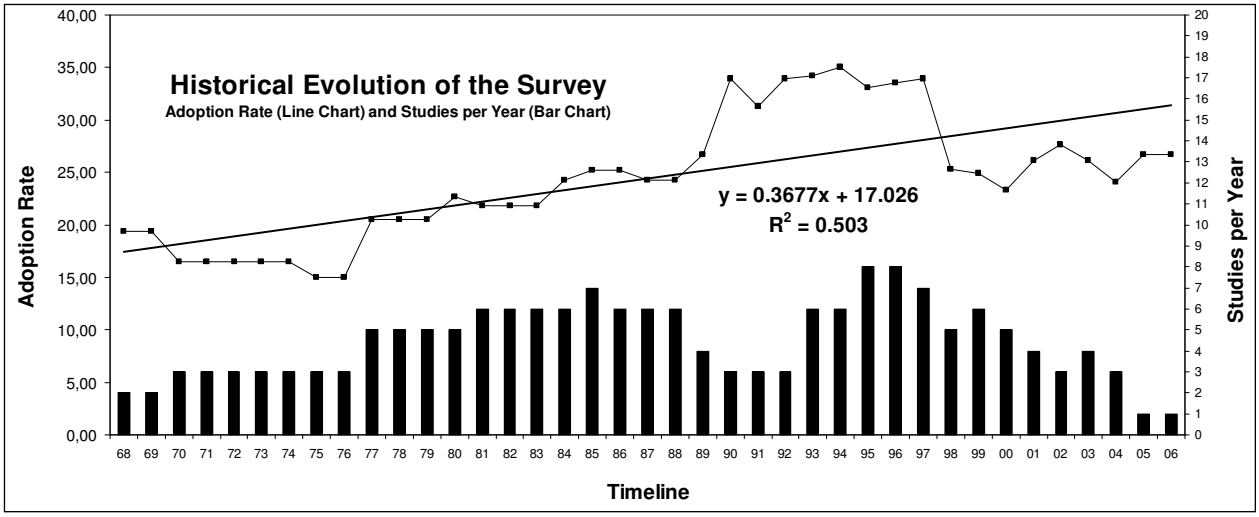

Figure 1. Data Analysis and Historical Development of the Survey (1968-2006)

Case Study

The historical development of the case study shows an upward tendency (m = 0.2266; Figure 2); the descriptive statistics for the adoption rate (in percent) are: mean: 13, median: 13, standard deviation: 4. In 1989 and 1990, the case study demonstrated its maximum adoption rate of 19 percent. At this time almost every fifth IS article in our sample employed the case study method. In a literature analysis, Palvia et al. (2003) found a correlation between topic and research method. Interestingly, the heyday of important management topics in IS research, for example IT outsourcing (Dibbern et al. 2004), coincided with the peak in the use of the case study. Therefore, the dedication to particular management topics such as outsourcing in the late 1980s can be a cause of the popularity of the case study.

	Adoption Rate of the Case Study	Note	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
1	[Alavi & Carlson 1992]																																								
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17	[Palvia et al. 2004]																																								
18	[King & He 2005]	A																																							
19	[Seddon & Scheepers 2006]																																								
20	[Ayanso et al. 2007]																																								
	Mean (Adoption Rate of the Case Study)	B	4	4	7	7	7	7	7	7	7	13	13	13	13	14	14	14	15	16	14	13	13	19	19	16	16	16	16	16	17	17	18	16	17	14	11	11	11	12	12
	Studies per Year		2	2	3	3	3	3	3	3	3	5	5	5	4	5	5	5	5	6	5	5	5	3	4	4	4	6	6	8	8	7	6	6	4	3	2	3	2	1	1

	Adoption Rate of the Case Study	Note	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
1	[Alavi & Carlson 1992]																																								
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9	[Farhoomand & Drury 1999]																																								
10	[Dubé & Paré 2003]	B																																							
11	[Chen & Hirschheim 2004]	B																																							
12	[Lightner & Nah 1998]	A																																							
13	[Palvia et al. 2003]																																								
14	[Mingers 2003]																																								
15	[Glass et al. 2004]																																								
16	[Vessey et al. 2002]																																								
17	[Palvia et al. 2004]																																								
18	[King & He 2005]	A																																							
19	[Seddon & Scheepers 2006]																																								
20	[Ayanso et al. 2007]																																								
	Mean (Adoption Rate of the Case Study)	B	4	4	7	7	7	7	7	7	7	13	13	13	13	14	14	14	15	16	14	13	13	19	19	16	16	16	16	16	17	17	18	16	17	14	11	11	11	12	12
	Studies per Year		2	2	3	3	3	3	3	3	3	5	5	5	4	5	5	5	5	6	5	5	5	3	4	4	4	6	6	8	8	7	6	6	4	3	2	3	2	1	1

Note: A = Study does not include the case study method / B = Figures in the row are rounded to whole numbers due to space limitation in the cells.

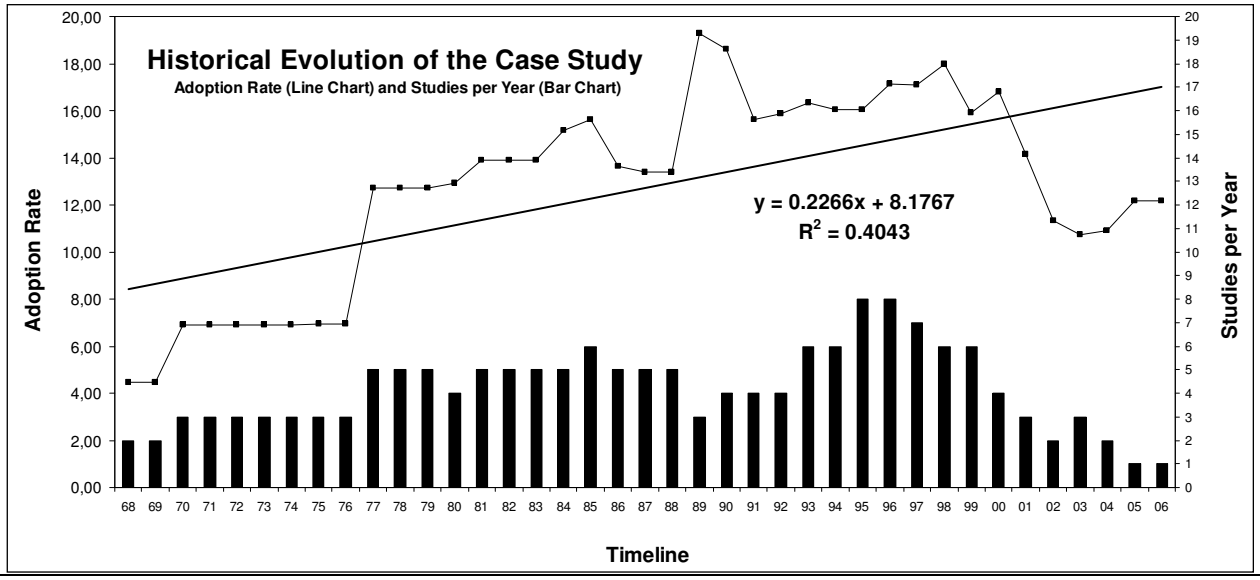

Figure 2. Data Analysis and Historical Development of the Case Study (1968-2006)

Laboratory Experiment

The historical development of the laboratory experiment shows an upward tendency (m = 0.2618; Figure 3); the descriptive statistics for the adoption rate (in percent) are: mean: 10, median: 8, standard deviation: 3. In contrast to the development of the survey and case study, R^2 is much higher (0.8598). That is, the regression line passes better through the data points. Hence, the regression line explains more of the variation in the data than do the regression lines in Figures 1 and 2.

The increasing maturity of the IS discipline, in particular, is likely to have resulted in the application of lab experiments, since experiments allow for testing the theories generated during the previous decades. In 2005-2006, the laboratory experiment showed its maximum adoption rate of 16 percent. Since the mid 1990s, about every seventh IS article has been based on laboratory experimentation. Considering that IS not only investigates the individual and group level, for which laboratory experiments are an appropriate research method, but also organizations and even societies, this value is considered as relatively high (Galliers and Land 1987).

	Adoption Rate of the Laboratory Experiment	Note	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
1	Alavi and Carlson (1992)		7.27																																						
2	Alavi et al. (1989)		7.20																																						
3	Hamilton and Ives (1982)				4.60							5.60																														
4	Vogel and Wetherbe 1984)												14.85																												
5	Farhoomand (1987)											4.10																													
6	Grover et al. (1993)	A																																							
7	Claver et al. (2000)															8.22			3.85			6.37			6.27			11.33			8.46									
8	Lending and Wetherbe (1992)																			10.68																					
9	Farhoomand and Drury (1999)																							10.78																	
10	Dubé and Paré (2003)	A																																							
11	Chen and Hirschheim (2004)	B																								14	11	15	8	9	15	9	7	14	11	7					
12	Lightner and Nah (1998)																											15													
13	Palvia et al. (2003)																											15.30													
14	Mingers (2003)	A																																							
15	Glass et al. (2004)																														16.8										
16	Vessey et al. (2002)	C																																							
17	Palvia et al. (2004)																																12.4								
18	King and He (2005b)																																	14.11						
19	Seddon and Scheepers (2006)	A																																						
20	Ayanso et al. (2007)																																		16.45					
	Mean (Adoption Rate of the Laboratory Experiment)	B	7	7	6	6	6	6	7	7	8	8	8	8	8	8	8	7	7	8	8	8	9	9	10	9	14	12	13	14	13	12	14	13	13	14	14	15	16	16
	Studies per Year		2	2	3	3	3	3	3	3	5	5	5	4	5	5	5	5	6	5	5	5	3	3	3	3	5	5	6	6	5	3	4	4	4	3	3	2	1	1

Note: A = Study does not include the laboratory experiment / B = Figures in the row are rounded to whole numbers due to space limitation in the cells, C = Study does not report the adoption rate in appropriate format.

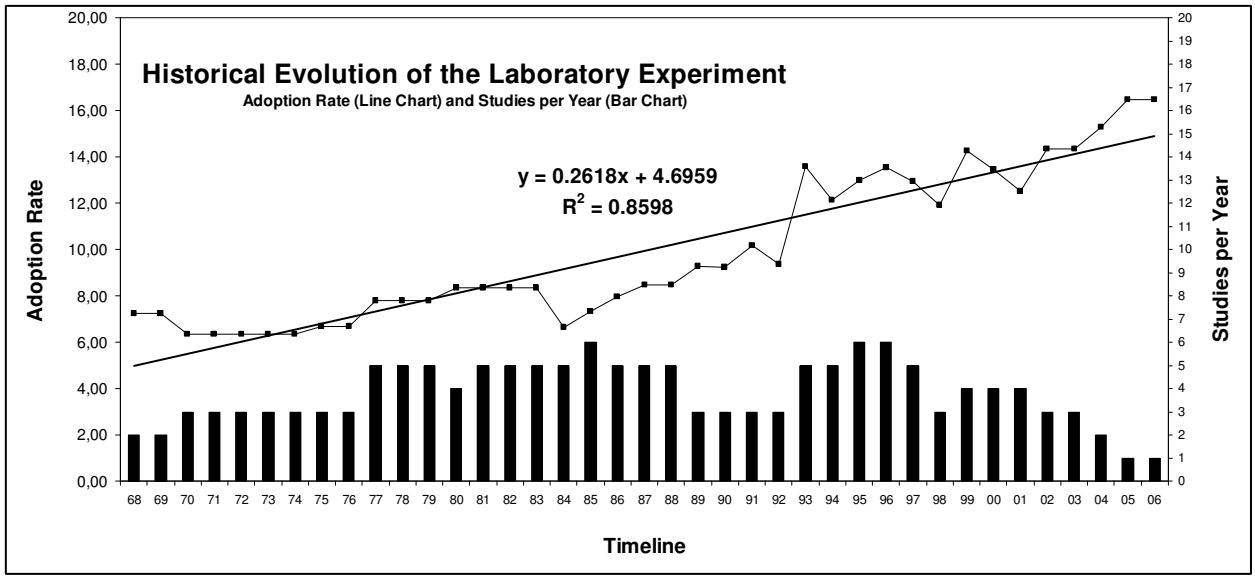

Figure 3. Data Analysis and Historical Development of the Laboratory Experiment (1968-2006)

Field Experiment

The historical development of the field experiment in the IS discipline demonstrates almost no tendency (m = 0.0002; Figure 4). It should be pointed out that R^2 is very low in the case of the field experiment (3E-06, hence ~0). This indicates that the regression line explains little of the variance in the data points. The descriptive statistics for the adoption rate (in percent) are: mean: 3, median: 2, standard deviation: 1. Most striking is the fact that the adoption rate is relatively low in general.

As Figure 4 shows, the maximum adoption rate of the field experiment can be observed in the late 1970s, 2005, and 2006 (5 percent). Although the field experiment has high epistemological value for the IS discipline—the study of Franz et al. (1986) may serve as an example—IS scholars seldom employ the field experiment. Two possible reasons are: First, we believe that it is often difficult for IS researchers to find a sample of organizations showing a natural variance in the independent variables analyzed. Second, we are not aware of a paper published in the IS literature that explicitly advocates the use of the field study, whereas the employment of other empirical methods has been advocated several times in each case (e.g., Benbasat et al. 1987, Cavaye 1996, and Lee 1989 argued for case study research).

	Adoption Rate of the Field Experiment	Note	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
1	Alavi and Carlson (1992)		1.98																																						
2	Alavi et al. (1989)		2.02																																						
3	Hamilton and Ives (1982)				2.60					6.20																															
4	Vogel and Wetherbe (1984)											11.40																													
5	Farhoomand (1987)															1.70																									
6	Grover et al. (1993)	A																																							
7	Claver et al. (2000)															0.00			1.28		1.59			0.39			0.78			1.54										
8	Lending and Wetherbe (1992)																		3.77																						
9	Farhoomand and Drury (1999)																			2.33																					
10	Dubé and Paré (2003)	A																																							
11	Chen and Hirschheim (2004)	B																							2	1	0	1	1	1	1	1	2	1	1						
12	Lightner and Nah (1998)	A																																							
13	Palvia et al. (2003)																											2.73													
14	Mingers (2003)	A																																							
15	Glass et al. (2004)																														1.6										
16	Vessey et al. (2002)	C																																							
17	Palvia et al. (2004)																																								
18	King and He (2005b)																																								
19	Seddon and Scheepers (2006)	A																																							
20	Ayanso et al. (2007)																																								
Mean (Adoption Rate of the Field Experiment)		B	2	2	2	2	2	2	2	3	3	5	5	5	4	3	3	3	2	2	2	2	3	2	2	1	1	2	2	2	2	2	3	3	3	3	3	5	5
Studies per Year			2	2	3	3	3	3	3	3	3	5	5	5	4	5	5	5	5	6	5	5	5	3	3	3	4	4	5	5	4	3	4	4	4	3	3	2	1	1

Note: A = Study does not include the field experiment / B = Figures in the row are rounded to whole numbers due to space limitation in the cells / C = Study does not report the adoption rate in appropriate format.

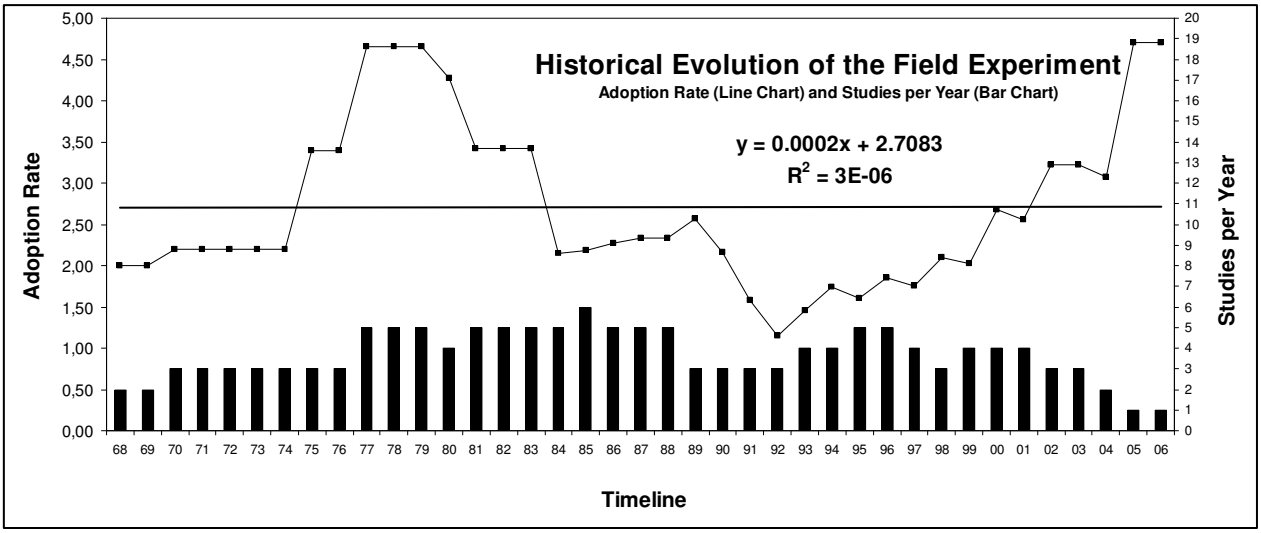

Figure 4. Data Analysis and Historical Development of the Field Experiment (1968-2006)

KEY FINDINGS AND IMPLICATIONS

In the present investigation, we integrated the results of twenty meta-studies to reconstruct the historical development of research methods in the IS discipline. Until the late 1970s, non-empirical articles (i.e., conceptual or opinion-based articles) dominated IS research. Van Horn (1973, p. 179), for example, analyzed the rate of empirical papers that were presented at IS conferences in the late 1960s and early 1970s. He found that only 22 percent of the papers "report directly on empirical research." However, in the late 1970s and 1980s well-known empirical research methods from the social sciences (survey, case study, and experiment) incrementally found their way into the IS discipline. During the past four decades, survey, case study, and laboratory experiment have shown an upward tendency in their use, and today these methods dominate IS research.

Considering that (i) survey and experiment are both based on the natural science model and questionnaire/observation-based measurement tools (Mingers 2003, p. 238) and (ii) increasingly more case studies use quantitative and deductive research designs (Dubé and Paré 2003), our results indicate that a high proportion of IS research has been based on positivism in combination with traditional data collection methods from social sciences. Consequently, and this is a key finding of the present investigation, the IS discipline has *not* undergone revolutionary methodological changes (in terms of philosophy, research methods and measurement techniques) in the past forty years.

A main reason for this result could be that the main unit of analysis in IS research is the organization (Vessey et al. 2002) and most of the dominant methods in the IS discipline (survey, case study, and field experiment) are highly suitable for investigations at the organizational level. Hence, there has been no need for changes.

However, although the organizational level has been the dominant level of analysis in IS research, we believe that the individual and group levels of analysis will become more important in the future, thereby having the potential to change the current use of research methods. In particular, we believe that the laboratory experiment will gain in importance, because on the individual and group levels of analysis increasingly more *measurement techniques* are available. Three important and relatively new techniques are: (i) clickstream analysis, (ii) eye tracking, and (iii) neuroscience approaches.

The use of clickstream data to analyze information acquisition processes of computer users is gaining considerable momentum (Riedl and Brandstaetter 2006, Riedl et al. 2008). Clickstream data can be defined as data that users generate as they move from page to page and click on items within a graphical user interface (e.g., a website), usually stored in log files. Hence, user behavior can now be investigated directly by tracing a user's information acquisition. Clickstream data is considered to be objective (Straub and Burton-Jones 2007), because it is not based on survey data, which may yield unreliable data due to memory distortion, interpretation, or an inability to recall facts (Todd and Benbasat 1987).

Eye tracking is the process of measuring the point of gaze, that is, where a person is looking. This method has not only been used in research on the visual system in medicine, but also in cognitive psychology and marketing. In recent years, increasingly more IS scholars have started research programs with a focus on eye tracking data (Cyr et al. 2009). In human-computer interaction research, for example, it has been argued that eye movements can be used as an input device (Zhai 2003). In contrast to traditional input channels such as a mouse or keyboard, eye-gaze input can be much faster. Furthermore, computer user information acquisition can be captured with eye tracking equipment (Lohse and Johnson 1996). In a recent study, Lorigo et al. (2008) investigated how users view the ranked results on a search engine results page, the relationship between the research result abstracts viewed and those clicked on, and whether gender, search task, and search engine influence these behaviors.

In addition to clickstream analysis and eye tracking, recent IS papers have discussed the idea of applying neuroscience techniques (e.g., functional magnetic resonance imaging, fMRI, and electroencephalogram, EEG) to inform IS research to supplement, complement, and even question the hegemony of popular IS theories, methods, and data (Dimoka et al. 2010). Topics with a direct link to neuroscience are, for example, technology adoption and use, electronic commerce, trust in online environments, and group decision support systems (Dimoka et al. 2007). Recently, an annual conference—the so-called *Gmunden Retreat on NeuroIS*—was established to discuss important past achievements, current research projects, as well as possible avenues for the future development of NeuroIS (see Riedl et al. 2010a, *www.NeuroIS.org*). Moreover, fMRI was applied to (i) explain gender differences in IT behavior (Riedl et al. 2010b), (ii) show that trust and distrust in online shopping are not the two ends of one continuum but rather two distinct constructs (Dimoka 2010), and (iii) shed light on the nature of social presence in the context of anthropomorphic user interfaces (Benbasat et al. 2010). These three fMRI studies demonstrate the potential of neuroscience approaches to advance IS theorizing.

The laboratory experiment has continuously increased in popularity over the past forty years. In particular, in contrast to the other methods, the lab experiment's R^2 is very high (0.8598). That is, the linear regression line depicted in Figure 3 explains a large quantity of the variance in the data. We believe that the positive development of the laboratory experiment will continue in the future, because clickstream analysis, eye tracking, and brain imaging are typically used in experimental settings.

LIMITATIONS AND FUTURE RESEARCH

In the present investigation, we integrated the results from twenty meta-studies to reconstruct the historical development of research methods in the IS discipline. The results of the investigation, therefore, are dependent on the data provided in these twenty studies. The twenty meta-studies present two limitations. First, sample bias influences the generalizability of the results. That is, as indicated in Table 2, most meta-studies have a strong focus on mainstream journals. Hence, other high-quality journals (e.g., *Information and Organization*) are not well represented in the sample. Second, the journals in the sample are mainly North American publication outlets. Hence, European IS research in particular is not well represented in the sample. As indicated in Table 3, the sample bias affects the present investigation, since we only analyzed the four most investigated research methods. Importantly, three of the four methods (survey, laboratory and field experiment) are considered to be positivist and quantitative in nature, and this reflects the current practices of North American IS research (Chen and Hirschheim 2004). Therefore, while we believe that the present investigation is a reasonable effort, we do not yet see this work as complete. That is, we propose that other IS academics should consider the present investigation as an opportunity to triangulate with data drawn from journals outside North America. Although we already know that there are differences regarding research methods, for example, between North America and Europe (Chen and Hirschheim 2004,

Evaristo and Karahanna 1997), to our knowledge these differences have not yet been integrated systematically in a review that spans the period from the late 1960s up to now. Hence, future research efforts may concentrate on the reconstruction of the historical development of research methods in Europe, Asia, or Australia.

SUMMARY AND CONTRIBUTION

In this article, we have aggregated the results of twenty meta-studies, which report on the adoption of research methods in the IS discipline. By conducting the present investigation, we reconstructed the historical development of research methods in the IS discipline. Major results of the present investigation are:

- Even though many research methods are available to IS researchers, only the classical empirical methods (survey, case study, laboratory experiment, and field experiment) have been the subject of intensive discussion in the twenty meta-studies.
- Survey, case study, and laboratory experiment demonstrate an upward tendency in their historical development during the past forty years, whereas the field experiment does not.
- The investigation (1968-2006) found an average adoption rate of 24 percent for the survey, 13 percent for the case study, 10 percent for the laboratory experiment, and 3 percent for the field experiment.
- During the past four decades we have not observed radical methodological changes in the IS discipline; that is, we found slow rates of change.

We believe that our study is valuable because it adds to the reconstruction of IS history. Since knowing the methodological history is important to forming an IS identity, we consider this article to be a part of the identity discussion in the IS discipline (Benbasat and Zmud 2003). The development patterns of the research methods shown in Figures 1, 2, 3, and 4 are promising starting points for further investigations which seek to explain the patterns. The research method selection criteria which we summarize in Table 4 (see Appendix) may help to formulate high-quality explanations.

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APPENDIX

Table 4. Research Method Selection Criteria

Criteria	Example
1 Object of research	
1.1 What is the level of analysis?	*Studies at an individual or group level can be executed effectively by conducting laboratory experiments.*
1.2 What is the topic of the research study?	*IT outsourcing is a topic that is usually investigated by means of surveys and case studies.*
1.3 What is the research question?	*If a research question focuses mainly on a "How" and/or "Why" question, then case studies and experiments, respectively, are highly suitable.*
1.4 What is the aim of the study?	*If the aim of the study is explanation, then the use of an experimental design is more suitable than action research.*
1.5 What is the epistemological position of the study?	*Experimental research heavily draws upon the positivist paradigm, whereas hermeneutics is based on an interpretivist philosophy.*
1.6 Does the research study focus on theory development or theory test?	*Qualitative methods (e.g., case study or ethnography) more often focus on theory development than quantitative methods (e.g., survey or experiment), which in turn concentrate on theory testing.*
2 Research environment	
2.1 Is a particular method widely accepted in the research community?	*Survey and experimental research are more accepted in North American research than qualitative methods.*
2.2 How mature is the discipline?	*In mature disciplines methods that aim at theory testing (e.g., experiments) are used more often than theory developing methods (e.g., explorative case studies).*
2.3 How much does it cost (in terms of money) to apply a particular method?	*The use of cognitive neuroscience methods (e.g., functional magnetic resonance imaging, fMRI) is more expensive than collecting and analyzing survey data.*
2.4 Who is the intended audience for the publication of the research study?	*If practitioners are the intended audience, then action research and case studies are highly suitable methods, since they do not imply as much statistical knowledge as surveys and experiments do.*
2.5 Are secondary data available and appropriate for analysis?	*The availability of secondary data favors the empirical test of theoretical models.*
2.6 Are there any time constraints to completion of the research study?	*Longitudinal case studies are relatively time-consuming.*
2.7 How many researchers can be devoted to the research project?	*Case study research usually requires the availability of more manpower than a survey does.*
3 Individual-related factors	
3.1 Is the researcher an academic or practitioner?	*The rate of practitioners who conduct case study research is higher than the rate of practitioners who conduct laboratory experiments.*
3.2 Is the researcher trained in a particular method?	*A person who was trained in survey research is more likely to apply this method than a person who was not.*
3.3 Is the language of the publication the researcher's native language?	*The communication of substantive elements in qualitative research (e.g., case studies) is particularly sensitive to how well the publication is written.*
3.4 What are the researcher's preferences?	*A scholar who is attracted to action research (because she likes to interact with organizations and change reality) is more likely to use this particular method than other methods.*
3.5 For which institution does the researcher work?	*Academic institutions often focus on a particular method (e.g., Harvard case studies).*
4 Method-related factors	
4.1 Is a replication of the study possible?	*Laboratory experiments can be replicated, whereas action research cannot.*
4.2 Is the rigor of the research more important than its relevance?	*Laboratory experiments are assumed to be carried out with maximum objectivity, i.e., they imply the highest possible level of rigor. In contrast, action research aims at changing organizations, thereby being highly relevant for practitioners.*
4.3 Is the internal validity of the research findings more important than their external validity?	*The validity of causal inferences in experimental research is higher than in studies with no experimental control (e.g., ethnography).*
4.4 Are process or variance variables investigated?	*The investigation of process variables (e.g., organizational learning) can be executed more reliably by using methods with longitudinal designs (e.g., case studies).*

Sources: Benbasat et al. (1987), Claver et al. (2000), Dubé and Paré (2003), Farhoomand (1987), Farhoomand and Drury (1999), Galliers and Land (1987), Grover et al. (1993), Hamilton and Ives (1982), Palvia et al. (2003), Vessey et al. (2002).